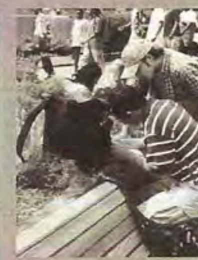
Art & Literature

Science



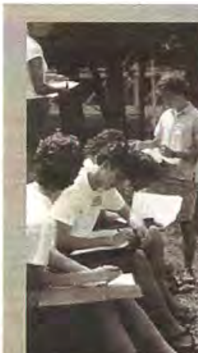
Come On, Get Happy
Lake Winnepesaukah
Amusement Park
CHATTANOOGA - TENNESSEE

EDUCATION DAYS
LEARNING IS A SCREAM AT LAKE WINNIE!
LAKE WINNEPESAUKAH

Physics Day

Enclosed are some teaching suggestions given at one of the Physics Alliance of Chattanooga meetings by high school physics teachers. Several teachers treat Physics Day as multiple lab grades, with a report due after the event. Others have given a test over the material, or included significant portions of the calculations on their final exams. Others have taken a class period after the event to review the calculations and discuss the measurements. All teachers reviewed much of the material pertaining to the physics of the rides before the day at the park. Everyone said they think of this event not as a field trip, but as a long and exciting laboratory experiment. We hope you do too!

SOCIAL STUDIES



MATH & PHYSICS

Developed by Randolph S. Peterson
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PHYSICS DAY
Teacher's Guide

TEACHING SUGGESTIONS FOR PHYSICS DAY

CIRCULAR MOTION

Motion on a circle requires a force on the object pulling toward the center of the circle. Unfortunately we have given this force a name, as if it exists along with gravitational, electromagnetic, weak, and strong forces. It does not; it is just a force with special direction. Whatever the true nature of the force, its "ma" from Newton's second law is, "mv^2/r". This is what we are exploring in the **Carrousel**, **Ferris Wheel**, a little on the **Cannon Ball roller coaster**, and the **Swinging Pirate Ship** rides. Your gravitational attraction to the earth (mg is always present, so the force that moves you in a circle is added, (as vectors add), to "mg". The orgin of tight circle-making force is a seat of the ride, which is ultimately an electromagnetic force!

If you have not taught circular motion, try just a little, making it clear that the mathematical form of the acceleration is for a special motion, not a special force. As a demo, firmly attach a mass to a string and run the string through a 30cm. (1 ft.) length of a 3/4 inch PVC pipe. Attach a spring force gauge to the other end of the string and twirl the attached mass in a horizontal circle, measuring the force and the radius when the radius does not change. Be certain the attached mass is several times greater than the string's mass. Be careful, this is just a sling with the shot waiting to be released.

Coupled with the circular motion is the superposition of forces, ("seat" plus "mg") on the Pirate Ship and the Ferris Wheel. There is always some confusion about how many g's there are. Remember that your mass gives "one g" and the other forces give the rest. There vertical accelerometers (with the springs) have been calibrated to read the total g's. Subtract one "g" to get the acceleration for the circular motion. The bathroom scales read the total force, including "mg". Subract "mg" to get the force causing the circular motion. Do your students know their weight,"mg" in Newtons? Show them how to calculate it, and their mass as well.

PENDULUM MOTION

So much physics, chemistry, and engineering are built around the pendulum. If you have not studied it yet, it is more important than circular motion. It is important to see that for a small oscillations that the period is independent of the mass. We will observe pendulum motion with the Pirate Ship, and the large angle motion suggests that the simple equation for the period will not work very well, but it does. Measuring the pendulum length requires some cleverness.

Try a class experiment of measuring the period for different lengths. Then turn the experiment around and have them determine the length of a pendulum from its period. Hanging the unknown length out a second story window is quite effective. Remember that all materials stretch (strain) when stressed.

CONSERVATION OF MECHANICAL ENERGY

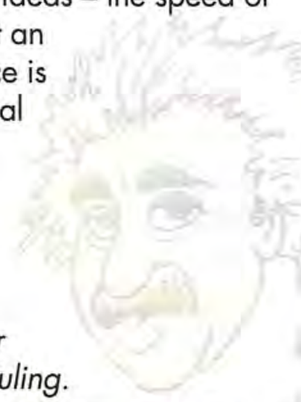
Conservation of energy is a topic on which I know that you have spent some time. Here is an opportunity to test Lake Winnie's claim that the roller coaster moves at speeds up to 55 mph. All the energy the roller coaster has is its gravitational potential energy at the top of the first hill. At the bottom of the first hill, all that potential energy has become kinetic energy. Only the height of the first hill, relative to the bottom of the hill is needed to determine the speed, and that height can be measured with just a little trigonometry.

ROTATING COORDINATE SYSTEMS

On a rotating system, Newton's three laws of motion do not "appear" to work. This is especially obvious for motions of small masses moving at small speeds over large distances. The circulation of air about a low-pressure front is just such an example. Where are the "forces" that "make" the air rotate in a counterclockwise manner in the Northern Hemisphere? Motion in accelerating systems (rotating systems are accelerating systems) is the foundation of Einstein's Gerneral Theory of relativity. rolling balls on the floor of the carrousel provides the same effect as the low pressure on earth. And, from an observer's point of view on the Carrousel, Newton's first law does not visually appear to be true. This, of course, is your evidence that the reference frame (the floor of the carrousel) is not an inertial frame but an accelerating frame of reference.

RELATIVITY IN THE PARK

Einstein's Special Theory of Relativity is based upon just a few ideas – the speed of light in a vacuum is the same for all observers, and there is not an experiment that can determine which of two frames of reference is moving absolutely, if those frames are inertial frames. An inertial frame is a place that is moving in one direction at a constant speed. The carrousel is not such a place.



Lake Winnepesaukah, UPON REQUEST WHEN ENTERING THE PARK, will provide an opportunity to conduct the following experiment at an appointed time. As there are other guests in the park, this can only be done with advance scheduling.

ACCELERATIONS AND FORCES

Have two students ride the carrousel together. Give them a tennis ball and have them position themselves in a safe position to be able to roll the tennis ball back and forth to each other. The floor inclines toward the center just a bit, so you may expect some curvature in the ball's path.

From the point of view of the person rolling the ball, which direction does the ball deflect, (to the right or the left), when the ride is moving? Does it matter whether you are rolling the ball tangent to your motion or perpendicular?

Direction = ____________________

Discuss with the class afterwards whether the Carrousel is an inertial frame and why you think so.

A frame of reference attached to the surface of the earth is not an inertial frame. The effects can be seen in the Coriolis effects we call hurricanes and tornadoes.

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